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TRAINING MODELLING FOR ASSESSING THE ACCURACY OF WATER POLO PLAYERS OF DIFFERENT QUALITATIVE LEVEL

Abstract

Evaluation of importance of technology and its impact on the accuracy of the shots in terms of the current state of optimal muscle and after the occurence of local fatigue, was conducted on the sample of 25 water polo players of different qualitative level. The quality of throwing the ball in the pool (valorised by expert appraisal) has been identified as a significant predictor of water polo players' accuracy, both in terms of the current state of the optimal muscle and the local fatigue. By the regression analysis, a significant positive impact of the tecnique on the accuracy of water polo shot has been demonstrated. It has been estimated by the number of winning points in the test of shooting the target. All of the three regression models (linear, logarithmic and exponential) pointed to the same conclusion, whereas the graphic models of the regression line were defined in relation to the position of regression points, and they played an insignifact deviation.

Key words: *Tecnique, Accuracy, Shot*

INTRODUCTION

The tecnique of water polo shot involves series of structural and mechanical movements that occur above and bellow the water surface, which are invisible to the human eye but very significant. Observer visually perceives only player's head, left or right shoulder and left or right arm. Other 75% of the body is under the water and practically invisible. Coaches call the shooting „the Holy Trinity", referring to the outstreched weaker (with most players left) arm which is slightly bent and represents a single point of support, then one leg and then the other as the other two points of support (Sarenac, 1981). Proper shooting however, requires a series of stages that are realised directly after releasing the ball from the hands. The first stage involves lifting the ball up by the pressure or venture. When lifting the arm that throws the ball over the shoulder, the rotation of hips and the cranial part of the body is being made simultaniously. The torso height above the water during the performance of the shot is a critical factor in training methodology (Newland, 2005).

Players must reach maximum point above the water using the strong pressure of the lower extremities („the scissors“), they must raise their bodies so that they could properly use torso rotation and stimulate the upper body for the final stage of throwing the ball. Farther point of ball swing reaches an angle of 107 0 for top players, while the ball is on average 19 cm above and 33 cm behind the ear (Elliott, 1989). Legs participate in increasing the speed of preparation for the shot. Knees perform maximal flexion just before the shot and then the extension. The consequence is raising the upper body. This strong pressure of knees and hips, especially knee and hip opposite to the shooting hand , provides the necessary reaction required for the torso rotation and throwing the ball. Ideal indicators of water polo shot, however, do not always reflect the real situation in such conditions as competitive activities (match).

The player is rarely free and unimpeded for shooting. Players almost always have a defender between himself and the opposing goal so that they are forced to use quirky movements. Fatigue parameter is also an aggravating factor for the manifestation of technically formed movements.

METHOD

The research topic is the impact of fatigue on the accuracy of the water polo shot.

The survey aims to quantify the value of the predictor on the technical level of the water polo shot execution efficiency before and after the local fatigue of muscles.

The applied methodology

This study was conducted as an empirical study of the transverse character. During the planning of research and in the stage of comparing the results of the previous corresponding survey, a bibliographical method was used. As the main explanatory tool in the immediate operational stage of research, we have used an empirical – experimental procedure, whereas statistical method was applied in the stage of mathematical processing and inference. Data that comprise the original empirical base were collected using standardized motor tasks performed in the situational (field) conditions.

The sample of respondents

The sample of respondents, applied in this study, has the characteristics of the group sample, given that all respondents belong to a club. 25 of them are active members of the Senior Water Polo Club „Borac“ from Banja Luka. The subjects were male, aged 22 – 26 years, of normal health status. For research purposes, the entire sample was divided into three smaller groups(strata)according to the criteria of the quality of valuation techniques by the experts.

Variable patterns (Measuring instruments)

The research included two main variables of which one (the technique of throwing the ball out of the water) was hypothetical predictor, while the other (precision of throws)

had the status of a criterion. Shooting accuracy was evaluated in two situations: first, in optimum condition of muscles, and then in the state of fatigue. Fatigue was caused by rubber expanders which were used by the respondents in the form of dry shot simulation. 20 simulation shots were performed at maximum speed. After that, the subjects immediately entered the pool and performed the ball throwing precision test in the water.

Description of the test

By estimating the tecnique of performing a water polo shot, three groups(strata)of different qualitative level respondents were formed. Quality assessment of the tecniques were performed by three water polo experts. Respondents were throwing ball in pairs so that both participants were evaluated at the same time. Particular attention was paid to the position of the body while passing the ball, the appropriate rotation of the torso was assessed, the quality of the „scissors", horizontal position in receiving and passing the ball, coordination of movements and equalized rhythm of both subjects. Technique assessment ranged from 5 to 10.

At a distance of 6 meters, subject had a task to hit the rim of 50 cm diameter, which was attached to the top crossbar of the water polo goal. This was the way of assessing the shot accuracy. Hitting the middle of the rim was evaluated with 5 points while hitting the corner brought 3 points. Missing the rim brought no points. Respondents had five balls at their disposal which they threw by consistent, natural shooting rhythm. The final result of this criterion variable had been obtained by adding the points from all five throws. The same test of the situational precision was repeated after using the rubber expander which has provoked the local fatigue of muscles.

Methodology of data processing

The data collected using the described motor tasks were analyzed using the descriptive and comparative statistics. From the area of descriptive statistics, for all variables which are expressed as the minimum of ordinal scale, the representative central and dispersion parameters were calculated. From the area of comparative statistics, due to the small number of subjects in some strata, nonparametric discriminant procedures were used, Kruskal Wallis and Wilcoxon's test, during testing the significance of differences among different values, whereas regression analysis was applied for quantifying the technology impact in expressed precision in both situations (before and after fatigue).

RESEARCH RESULTS WITH DISCUSSION

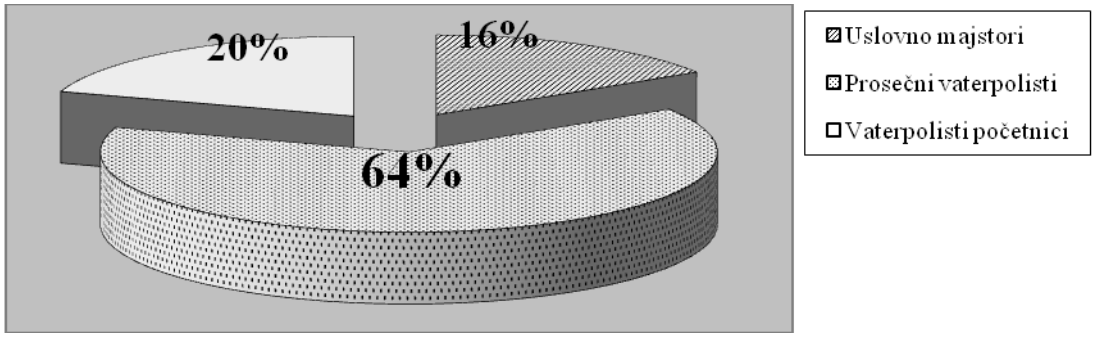
On the basis of expert assessment, the subjects were classified into three of the value categories – conditional masters, average and novice water polo players (Table and Picture 1). Not any of the subjects was rated with the grade 10, so that only four respondents who got 9 were classified as the strongest group, tentatively labeled as masters of water polo technique. Those who got grades 8 and 7 were marked as respondents with an average level of performance technique, and those with grades 6 and 5 were marked as a novice water polo players (Table and Picture 2). Among 25 respondents were most of those who were

rated as average (16 respondents or 64%), and much less of those with a minimum and maximum half of continuum value (16% of masters and 20% of beginers).

Judging by the distribution of expert evaluation of water polo technique with 25 subjects (Table and Picture 2), and the average value determined on the level of the entire sample and subsamples (Table and Picture 3), it can be concluded that the quality of water polo players in the survey was not of high level. Respondents with the grade 7 (the lower limit of the average) dominated the sample, so the overall average score barely passed seven. The most important thing from the methodological point of view were the strata which allowed the observation of certain principles on the expression of certain variability.

Table 1. *Distribution of respondents realized by the expert evaluation of the water polo technique*

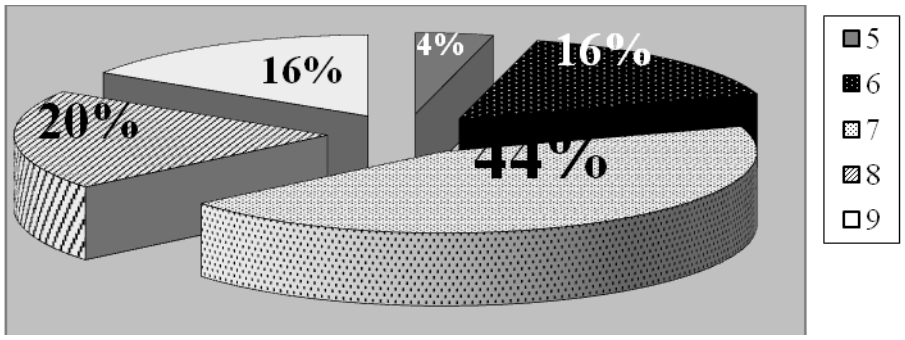
No.	**Subsample**	**Absolute frequency**	**Relative frequency**
1.	Conditional masters	4	16%
2.	Average water polo players	16	64%
3.	Novice water polo players	5	20%
∑		25	100%



Picture 1. *Distribution of respondents realized according to the expert evaluation of the water polo technique*

Table 1-2 *Distribution of expert evaluation of water polo technique among 25 respondents*

Expert evaluation	**Absolute velocity**	**Relative velocity**
5	1	4%
6	4	16%
7	11	44%
8	5	20%
9	4	16%
10	0	0

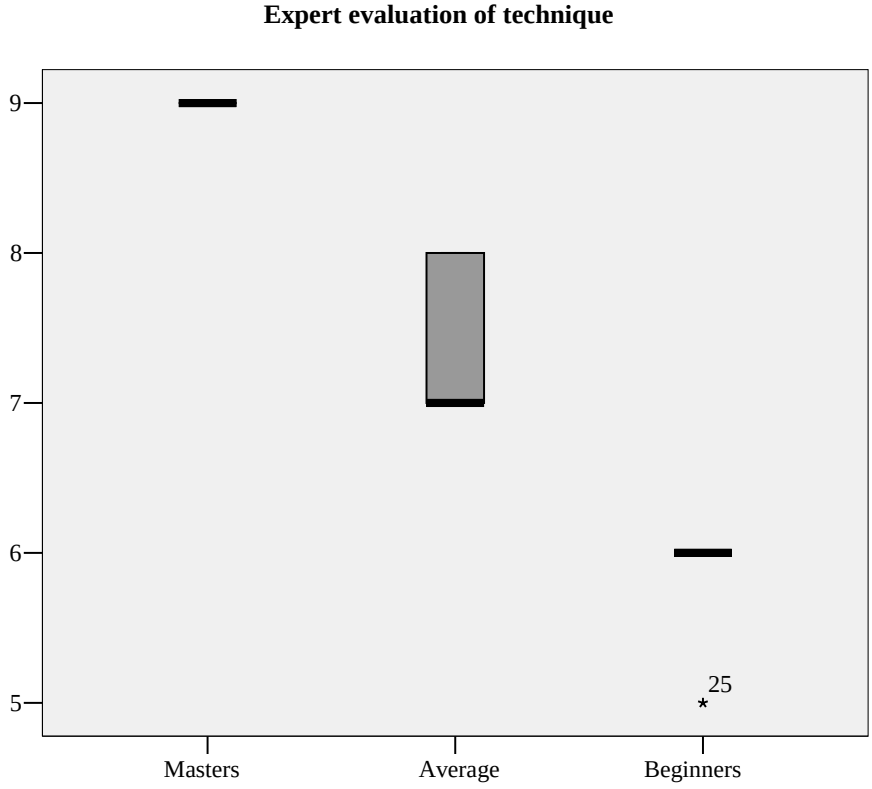


Picture 1-2 *Distribution of expert evaluation of the water polo technique among 25 respondents*

Table 3. *Descriptive statistical parameters obtained on the basis of expert evaluation of the water polo techniques. The significance of differences between the subsamples was tested with Kruskal-Wallis test*

Subsample	Average (M)	Std. Er.	Std. Dev.	Min	Max
Parole masters	**9,00**	0,000	0,000	9	9
Average water polo players	**7,31**	0,479	0,120	7	8
Waterpolo players beginners	**5,80**	0,447	0,200	5	6
Total sample	**7,28**	1,061	0,212	5	9

$\chi^2 = 19{,}385^*$ *Sig.* =.000



Picture 3. *Average values and width variation specified for the water polo expert technique evaluation among three subsamples of respondents*

Based on the original measurement results especially for each sub-sample, representative central and dispersion statistical parameters are calculated for one predictor and two criteria variables (Table 4,5 and 6). A broad outline of the absolute values of arithmetic means shows that the best results are achieved by the best group of respondents (respondents with the highest grades in throwing techniques). The final assessment of the statistical significance of these differences was confirmed by discriminative analysis. The values of dispersion parameters indicated high homogeneity within specific subsamples of respondents.

Table 4. *Descriptive statistical parameters determinated for the sub-sample of the best water polo players*

Variables	**Average** (M)	**Std. Er.**	**Std. Dev.**	**Min**	**Max**
Optimal accuracy (points)	**17**	1,155	0,577	16	18
Accuracy in fatigue (points)	**11,75**	3,5	1,75	8	16

Table 5. *Descriptive statistical parameters determinated for the sub-sample of average water polo players*

Variables	**Average** (M)	**Std. Er.**	**Std. Dev.**	**Min**	**Max**
Optimal accuracy (points)	**10,38**	3,481	0,870	3	18
Accuracy in fatigue (points)	**8,63**	2,941	0,735	3	15

Table 6. *Descriptive statistical parameters determinated for the sub-sample of the weakes water polo players*

Variables	**Average** (M)	**Std. Er.**	**Std. Dev.**	**Min**	**Max**
Optimal accuracy (points)	**7**	4,416	1,975	1	13
Accuracy in fatigue (points)	**7**	4,95	2,214	3	15

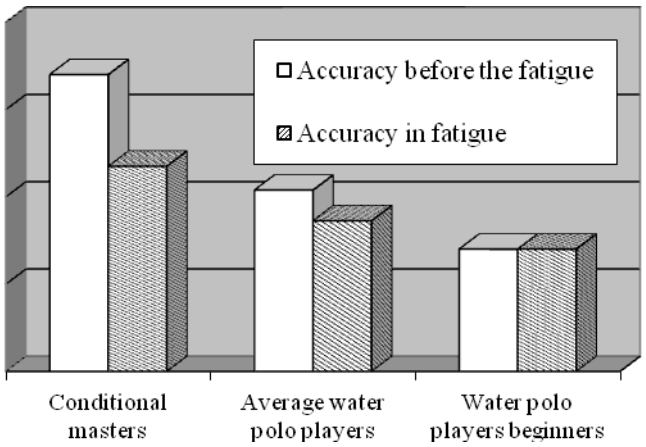
DISCUSSION

The significance of differences between the number of points made by respondents in the resting state and local fatigue, when performing tests of precision in throwing ball in the swimming pool, was tested by Wilcoxon's test. According to the obtained results (Table and Figure 7) it is visible that fatigue has more impact on better than on weaker water polo

players in reducing their precision. The realized significance levels were lower than the theoretical limit (Sig.<,05) on the subsample of masters and average players, while in the group with the lowest evaluated technique of throwing , these differences did not occur. Among the strongest group of players, accuracy declined by almost one-third (about 30.73%), among the average players by 15.12, while among the weakest it declined only 4.19%. Average values (means) among the weakest group of players did not even differ in absolute number in pre-testing and post-testing (in both time points were 7). Percentage difference is calculated as the arithmetic average of the statistical series established of percentage deviations for each respondent. Far more important (in terms of statistics) were realized levels of significance (last column in Table 7). They pointed out that the changes that occurred under the influence of local fatigue were significant in only two better groups. To sum up, it turned out that accuracy in throwing far more decreased among the water polo players with a high technical level, under the influence of the local fatigue. This phenomenon is consistent with current theoretical views about the impact of fatigue on the coordination and it is confirmed in some previous studies. (Nauten, Keskien & Vitalaso, 1995). Apparently, inhibition of neuromuscular synapses in this study appeared to be significant factor in the manifestation of parasitic sports technique.

Table 7. *Average accuracy in throwing the ball before and after and after the occurrence of local fatigue among respondents of different qualitative level.*

Subsample	Accuracy before the fatigue	Accuracy during the fatigue	The absolute difrerence	The relative difference	**Z**	*Sig.*
Conditional masters	17,00	11,75	-5,25	-30,73%	2,026*	**,048**
Average water polo players	10,38	8,63	-1,75	-15,12%	2,783*	**,005**
Water polo players beginners	7	7	0	4,19%	,000	1

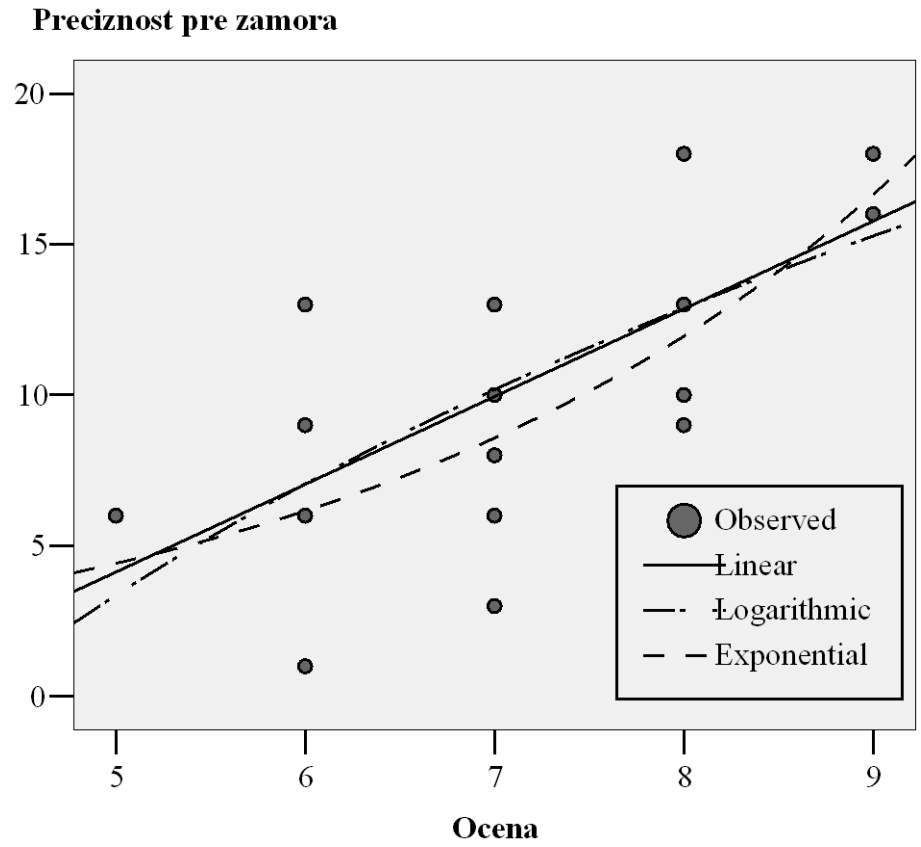


Picture 7 *Average accuracy in throwing of ball before and after the appearance of the local fatigue*

Quality in technique of throwing the ball in the pool (valorized by expert evaluation of observers) was identified as significant predictor in the accuracy of water polo players, both in terms of the normal state of muscle and in terms of local fatigue. A significant impact on the accuracy of the techniques of throwing the ball, which is valorized in number of points in the shooting test, has been proved by the regressive analysis. All three regressive models (linear, logarithmic and exponential) pointed to the same conclusion, while the graphic models of regressive line defined in relation to the distribution of regressive points had negligible deviations. (Table and picture 8)

Table 8. *Results of three models of regressive analysis (linear, logarithmic and exponential) which tested the impact of technology on the quality of accuracy in throwing the ball before the onset of fatigue*

Model	Constant	**b1**	R^2	F	Sig.
Linear	-10,423	2,910	*,465*	*19,974**	*,000*
Logarithmic	-29,281	20,277	*,442*	*18,207**	*,000*
Exponential	0,840	0,332	*,315*	*10,564**	*,004*



Picture 8 *Results of three models of regressive analysis (linear, logarithmic and exponential) which tested the impact of technology on the quality of accuracy in throwing the ball before the onset of fatigue*

CONCLUSION

- The results obtained showed that the fatigue has higher impact on reducing the precision among the better than among the weaker water polo players. Among the best group of players accuracy fell by almost a third, with the average players it fell of 15.12%, while with the weakest it fell of 4.19%. Average values of the weakest groups in pre-testing and post-testing did not even differ in absolute terms. These changes occurred under the influence of local fatigue and they were significant in only two better groups of players. It turns out that under the influence of the local fatigue, accuracy in throwing the ball decreases far more among the water polo players with a high technical level.

- A significant positive impact of technique on precision in shooting has been clearly demonstrated by regressive analysis. All three regressive models (linear, logarithmic and exponential) made the same conclusion and pointed to the very minimum deviation of the regressive lines. The results obtained, showed that the quality of the techniques evaluated by expert judgment may be taken as significant predictor in estimating the precision of shooting, before and after the local fatigue.

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